SUPER TYPHOON ISA (02W)

I. HIGHLIGHTS

The first of eleven super typhoons to occur in the western North Pacific during 1997, Isa formed at a low latitude in the Caroline Islands along the axis of the near equatorial trough. On the night of 16 April, Isa passed 140 nm (260 km) to the south of Guam. There was no significant damage reported (the peak wind gust on island was 61 kt (31 m/sec)), though peripheral rainbands of the typhoon produced rainfall of 6 to 10 inches (15 to 25 cm) across the island. Most of the objective track guidance available to JTWC turned Isa to the north well before it happened; a common model bias that is identified and explained in the model-traits knowledge base of the "Systematic Approach".

II. TRACK AND INTENSITY

The tropical disturbance that became Isa developed in a near-equatorial trough that had become established across Micronesia. On 09 April, a large cloud cluster with the characteristics of a monsoon depression formed in the Caroline Islands, and was subsequently described in the 09 April 0600Z Significant Tropical Weather Advisory (ABPW). Synoptic data and animated satellite imagery indicated that a large, weak, low-level cyclonic circulation accompanied this cloud cluster. After several cycles of mesoscale cloud cluster growth, dissipation and regeneration, the system acquired a persistent and well-organized area of deep convection on 11 April, prompting JTWC to issue a Tropical Cyclone Formation Alert (TCFA), valid at 0000Z. The first warning on Tropical Depression (TD) 02W was issued valid at 1800Z on 11 April, based on satellite intensity estimates of 30 kt (15 m/sec), cooling cloud tops, and increased organization of the outflow aloft.

TD 02W was a large tropical cyclone that intensified slowly. The strong, deep monsoonal westerlies to its south prevented much movement from 0000Z on 10 April to 0000Z on 12 April. Based on satellite intensity estimates of 35 kt (18 m/sec), 02W was upgraded to Tropical Storm Isa (02W) on the warning valid at 0600Z on 12 April. After becoming a tropical storm, intensification occurred more rapidly, and the system began to move toward the west-northwest. Isa was upgraded to a typhoon on the 13 April 1800Z warning. At this point, the motion of the system became more westward, and the rate of intensification slowed. During the six-day period from 0000Z on the 14th to 0000Z on the 20th, the intensity of the typhoon steadily increased from 65 kt (33 m/sec) to its peak of 145 kt (75 m/sec) (Figure 3-02-1). This rate of intensification (approximately one-half a T-number per day) is defined by Dvorak (1975, 1984) as slow. Approximately 36 hours prior to reaching peak intensity, Isa turned to the north, a major track change indicated by most of the numerical guidance for several days (although the models made the turn far too early). Moving slowly north along 137E during the 24-hour period from 20 April 0000Z to 21 April 0000Z, Isa began to weaken. At 0000Z, on 21 April, the typhoon turned to the north-northeast and doubled its forward speed to approximately 12 kt (22 km/hr) while continuing to weaken. At 0000Z on the 22nd, the typhoon, having weakened to 80 kt (41 m/sec), began to accelerate in the midlatitude flow and the speed of translation increased from 12 kt (22

km/hr) to 17 kt (32 km/hr) at 0000Z on the 23rd, and to 24 kt (44 km/hr) at 1200Z on the 23rd. The final warning on Isa was issued valid at 0600Z on the 23rd, as the system accelerated to the northeast and its cloud system became sheared. The remnants of Isa later merged with the cloud band on the northeast side of a vigorous extratropical low that had developed and moved eastward into the Pacific from northern Japan.

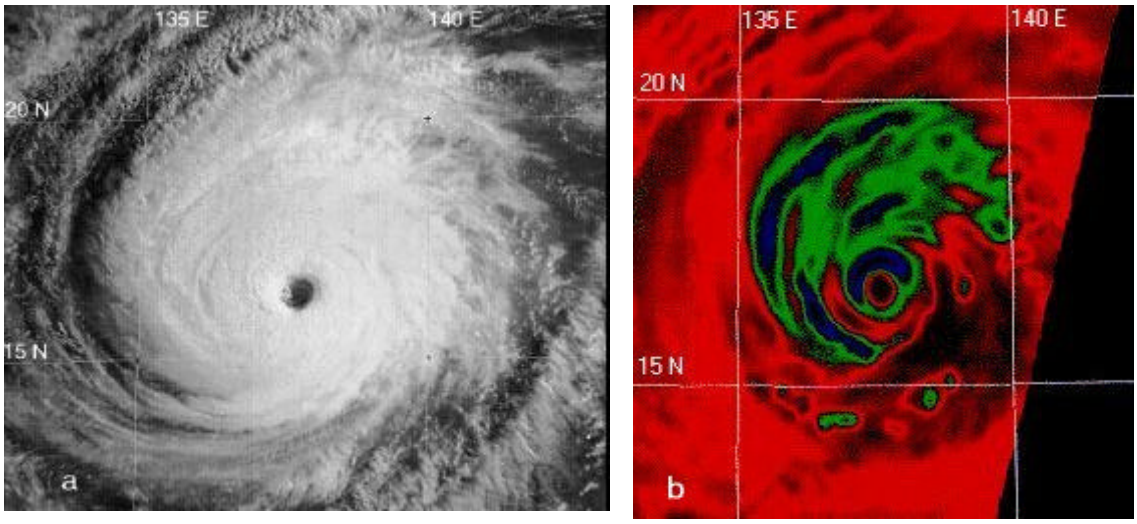


Figure 3-02-1 Isa near the time of its peak intensity. (a) Visible imagery within three hours of its best track peak (192131Z April visible GMS imagery) and (b) microwave imagery within two hours of the peak (200146Z April 85 GHz horizontally polarized microwave DMSP imagery).

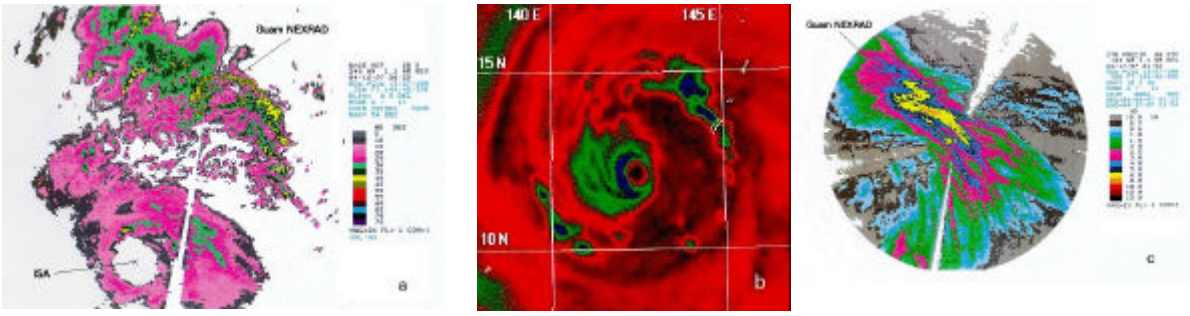


Figure 3-02-2 A peripheral rainband on the northeast side of Isa remained in a fixed position over Guam for over 12 hours resulting in rainfall totals of up to 10 inches. (a) As Isa's eye moved westward away from Guam, heavy showers and thunderstorms embedded in an outer rainband were directed over the island for an extended period (162029Z April NEXRAD base reflectivity). (b) The rainband as it appeared in microwave imagery (170805Z April 85 GHz horizontally polarized microwave DMSP imagery). (c) The narrowness of the ribbon of high amounts of rainfall is apparent on NEXRAD integrations of precipitation (NEXRAD storm-total precipitation ending at 172154Z April).

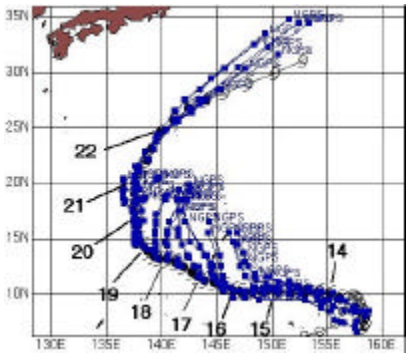


Figure 3-02-3 Most of the objective guidance available at the JTWC had a persistent and strong northward bias for much of Isa's track. (NOGAPS forecasts out to 72 hours are superimposed over Isa's best track.

III. DISCUSSION

a. A Next-generation Radar (NEXRAD) view of Isa as it passed Guam

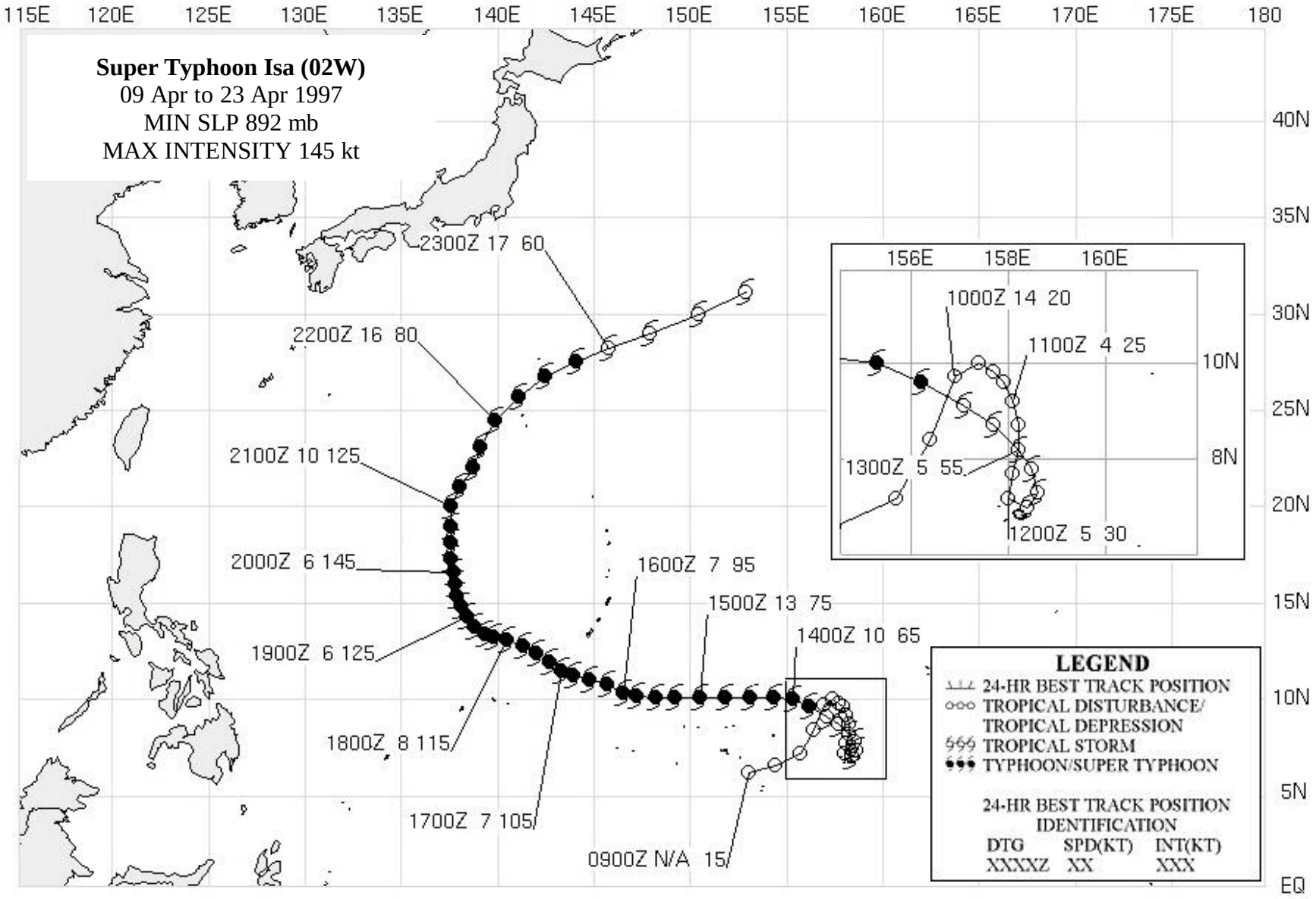
Isa passed closest to Guam during the early morning of 17 April. Most of the rainfall and the highest winds associated with the typhoon, however, occurred after Isa began moving away from the island, and was associated with a peripheral rainband (see the NEXRAD display of Figure 3-02-2a and the microwave imagery of Figure 3-02-2b). Twenty-four hour rainfall measurements on Guam approached 10 inches in some places. The NEXRAD storm-total precipitation product (Figure 3-02-2c) shows the narrow ribbon of very high rainfall produced over Guam (and adjacent ocean) by the nearly stationary typhoon rainband. Although the rainband was stationary, the convective elements within the band were moving rapidly northwestward in deep-layer southeasterly flow of 45-50 kt (23-26 m/sec).

b. Model biases

Numerical track prediction biases (predominantly those of the NOGAPS model), as described in the "Systematic and Integrated Approach" to tropical cyclone forecasting (Carr and Elsberry 1994), were observed in Typhoon Isa, particularly the NOGAPS tendency to prematurely turn a westward moving tropical cyclone to the north. Although JTWC forecasters were aware of the model bias and delayed forecasting the turn, the actual delay was longer than anticipated. JTWC forecast Isa's northward turn to occur near its actual closest point of approach to Guam, leading to over-forecasting of wind on the island. While the "Systematic Approach" deserves credit for alerting the forecaster's to the model's bias, and for correctly identifying that the northward turn would eventually occur, the turn was delayed for a very long time relative to other examples of this type, as illustrated in Carr and Elsberry (1994) and in training materials devised for the JTWC forecasters. Recent work by Carr (personal communication) on the problem of premature recurvature in model guidance (e.g., NOGAPS and GFDN) has led to new findings. In the early formulations of the "Systematic Approach", there were only two scenarios in which the numerical guidance tended to turn a westward moving tropical cyclone towards the north too early: 1) During cases of Indirect Tropical Cyclone Interaction, and 2) during cases of westward motion equatorward of a Dominant Subtropical Ridge when the model analysis of the tropical cyclone was too large. An additional scenario has recently been identified, and applies to Isa: Premature recurvature forecasts also occur in the transition seasons (spring; and late fall through early winter) when the subtropical ridge is meridionally thin, particularly if the tropical cyclone is intense. Presumably the intense tropical cyclone in the model is too large and drives through a weakness in the thin ridge sooner than its real-world counterpart (as was the case with Isa) or indicates a false recurvature in the case of a straight runner (as was the case with 05C, Paka).

IV. IMPACT

No reports of significant damage or injuries were received at JTWC. Welcome dry-season rainfall of up to 10 inches (25 cm) was recorded on Guam as Isa passed near.


Super Typhoon Isa (02W)
09 Apr to 23 Apr 1997
MIN SLP 892 mb
MAX INTENSITY 145 kt
115E
120E
125E
130E
135E
140E
145E
150E
155E
160E
165E
170E
175E
180
40N
35N
30N
25N
20N
15N
10N
5N
EQ
2300Z 17 60
2200Z 16 80
2100Z 10 125
2000Z 6 145
1900Z 6 125
1800Z 8 115
1700Z 7 105
1600Z 7 95
1500Z 13 75
1400Z 10 65
0900Z N/A 15
156E
158E
160E
10N
8N
1000Z 14 20
1100Z 4 25
1300Z 5 55
1200Z 5 30
LEGEND
24-HR BEST TRACK POSITION
TROPICAL DISTURBANCE/
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON/SUPER TYPHOON
24-HR BEST TRACK POSITION
IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XXX